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ORIGINAL RESEARCH ARTICLE

Response of okra (*Abelmoschus esculentus* L. Moench) to vermicompost, mycorrhiza and micronutrients mixture

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ABSTRACT

A field experiments on okra (*Abelmoschus esculentus* L Moench) cv. Arka Anamika" was conducted at Department of Vegetable Science, College of Horticulture and Forestry, Jhalrapatan city, Jhalawar during the Kharif 2016-17 to study the effect of vermicompost, mycorrhiza and micronutrients mixture of 16 treatment combination i.e. vermicompost with two levels (2 tons/ha and 4 tons /ha), mycorrhiza with one level (Mycorrhiza seed treatment) and micronutrients mixture with two levels (50 ppm and 100 ppm). The observations revealed that the plant height of *A. esculentus* after 60 DAS (74 cm), plant height after 90 DAS (79.71cm), number of leaves / plant (43.17), main steam diameter (5.52 cm), number of primary branches per plant (5.10) of *A. esculentus* and lowest days to first flower bud emergence (33.53) of A. esculentus was noted maximum as compared to control. The results indicates that plant height, number of leaves per plant, main stem diameter, stem girth, number of primary branches increased significantly due to application of different levels of vermicompost, mycorrhiza and micronutrients mixture as compared to control. It is postulated that the vermicompost 2tons and 4tons + mycorrhiza seed treatment + micronutrients mixture 50ppm and 100ppm may positively regulate the *A. esculentus* growth improved. Therefore, application of vermicompost, mycorrhiza along with a mixture of micronutrients played a significant role on enhancing the growth of okra (*A. esculentus*) and can be applied to obtain the maximum crop yield of okra (*A. esculentus*).

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INTRODUCTION

Okra (*Abelmoschus esculentus* L. Moench) popularly known as '*Bhendi*' is an important warm season vegetable, widely cultivated for its tender, green fruits. There are two cultivated types of okra (*Abelmoschus esculentus* L. Moench) and West African okra (*Abelmoschus caillei*). In India, okra mostly grown during Kharif (Chopra *et al*., 2013; Kumar and Chopra, 2013). It is also mature during premature winter period of mid cool temperatures when cost leftovers very high and farmers earn handsome remuneration from such an okra crop. Okra plays an important role in the diet by supplying carbohydrates, protein, fat, minerals and vitamins that are usually deficient in the staple food (Kumar *et al*., 2017). Okra is basically low in calories and dry matter constituents. Generally, it is consumed in a meal with basic starchy food makes the food more palatable (Savello *et al*., 1982; Ilodibia *et al*., 2017). Vermicompost acts both as plant growth promoter and plant growth protector. It keeps plants against numerous pests and diseases either by suppressing or resisting them or by inducing biological resistance in plants to fight them or by killing them through pesticide action (Sinha *et al*., 2010). Mycorrhiza is the edifices resulting from the association between fungi and plant roots and directly involved in plant mineral nutrition. The interdependent root-fungal association

increases the uptake of less movable nutrients (Ortas *et al.*, 2001). Zinc, Boron and Copper are essential trace element for plants being necessary for their good growth and development and involved in many enzymatic reactions. The role of Zinc in plant is due to its requirement in the synthesis of tryptophan (amino acid) which is a precursor of indole acetic acid (IAA) and formation of this growth substance is directly influenced by Zinc. Copper (Cu) is required for physiological redox processes, pollen viability and lignification (Marschner, 1995; Chopra *et al.*, 2017). Therefore, the present investigation was carried out to study the response of okra (*Abelmoschus esculentus* L. Moench) to vermicompost, mycorrhiza and micronutrients mixture.

MATERIALS METHODS

Experimental design and cultivation practices

A field experiment was conducted at the Department of Vegetable Science, College of Horticulture and Forestry, Jhalrapatan city, Jhalawar during *Kharif* 2016-17. The soil organic carbon 0.56%, available nitrogen 336.29kg/ha, available phosphorous 22.72kg/ha, available potash 220.69kg/ha. The direct seed sowing of cv. Arka Anamika at the spacing 45 × 45 cm by check-basin method in drip irrigation in randomized block design (RBD). A total 15 treatments (T_1- T_{15}) along with control were used for the cultivation of okra (*Abelmoschus esculentus* L. Moench). The description of different treatments is given in Table 1. The observations recorded on number of the plant height after 60 days after sowing (DAS), plant height after 90 DAS, number of leaves / plant, main steam diameter, primary branches per plant, days to first flower bud emergence.

Statistical analysis

The experimental data was expressed as mean ± S.E. One way analysis of variance (ANOVA) and least significant difference (RBD) was carried out using MS Excel to determine difference from control and between the treatments ($P \leq 0.05$).

RESULTS AND DISCUSSION

The effects of vermicompost, mycorrhiza and micronutrients mixture on various growth parameters *viz.*, plant height, number of leaves, stem diameter, number of primary branches and flower bud emergence of okra (*A. esculentus*) are presented in Table 2.

The result of present study clearly indicates that plant height, number of leaves per plant, main stem diameter, stem girth, number of primary branches increased significantly due to application of different levels of vermicompost, mycorrhiza and micronutrients mixture as compared to control. The maximum value of growth parameters *i.e.* plant height both at 60 and 90 DAS (74.00 and 79.71 cm), number of leaves per plant (43.17), main stem diameter (5.52 cm) number of primary branches (5.10). and Lowest day to first flower bud emergence (33.53) of okra (*A. esculentus*) was recorded under treatment T_{15} (vermicompost 4 tons/ha + mycorrhiza + micronutrients mixture @ 100 ppm) and the minimum value of growth parameters *i.e.* plant height both at 60 and 90 DAS (64.20 and 67.66 cm), number of leaves per plant (34.53), main stem diameter (3.50 cm), number of primary branches (2.77) of okra (*A. esculentus*) was minimum, and highest day to first flower bud emergence (40.73) were recorded under control (T_0). These findings clearly indicated that combination of vermicompost, mycorrhiza and micronutrients mixture played a significant role on enhancing the growth of okra (*A. esculentus*). These results are in close proximity with earlier researches of Mohandas (1987) in tomato, Vadiraj *et al.* (1998) in turmeric, Singh *et al.* (2002) in tomato, El-Rohidas *et al.* (2010) in garlic, El-Tohamy *et al.* (2009) in onion, Ramakrishnan and Selvakumar (2012) in tomato, Chowdhury *et al.* (2014) in okra, and Mehraj *et al.* (2015) in okra. Adequate supply of vermicompost early in the crop season resulted in greater availability of nutrients particular in crop root zone. Increased obtainability of nutrients in the root zone coupled with increased metabolic activity at the cellular level might have increased the nutrient uptake and accumulation in the vegetative plant parts which in turn resulted in improved plant growth attributes (Atiyeh *et al.*, 1999). With vermicompost application of mycorrhiza (bio fertilizer) might have increase higher absorption of nutrients, enhanced cell division, cell elongation and thus concomitant increase in metabolic activity (Torrey, 1950). Micronutrients (Zn) play an important role in many physiological process and cellular formation within the plants. The synthesis of tryptophan in the presence of zinc, the precursor of IAA, which stimulated the growth of plant tissues (Basavarajeshwari *et al.*, 2008).

Table 1. Description of different treatments used for cultivation of okra (*A.esculentus*).

S.N.	Symbols	Treatments
1.	T_0	Control
2.	T_1	V_1 (Vermicompost 2ton /ha)
3.	T_2	V_2 (Vermicompost 4ton /ha)
4.	T_3	M (Mycorrhiza seed treatment)
5.	T_4	Z_1 (Micronutrients mixture @50 ppm)
6.	T_5	Z_2 (Micronutrients mixture @100 ppm)
7.	T_6	V_1+M (Vermicompost 2ton /ha + Mycorrhiza seed treatment)
8.	T_7	V_1+Z_1(Vermicompost 2ton /ha + Micronutrients mixture @50 ppm)
9.	T_8	V_1+Z_2(Vermicompost 2ton /ha + Micronutrients mixture @100 ppm)
10.	T_9	V_1+M+Z_1(Vermicompost 2ton /ha+ Mycorrhiza seed treatment+ Micronutrients mixture @50 ppm)
11.	T_{10}	V_1+M+Z_2(Vermicompost 2ton /ha+ Mycorrhiza seed treatment+ Micronutrients mixture @100 ppm)
12.	T_{11}	V_2+M (Vermicompost 4ton /ha+ Mycorrhiza seed treatment)
13.	T_{12}	V_2+Z_1(Vermicompost 4ton /ha+ Micronutrients mixture @50 ppm)
14.	T_{13}	V_2+Z_2(Vermicompost 4ton /ha+ Micronutrients mixture @100 ppm)
15.	T_{14}	V_2+M+Z_1(Vermicompost 4ton /ha+ Mycorrhiza seed treatment+ Micronutrients mixture @50 ppm)
16.	T_{15}	V_2+M+Z_2(Vermicompost 4ton /ha+ Mycorrhiza seed treatment+ Micronutrients mixture @100 ppm)

Table 2. Effect of vermicompost, mycorrhiza and micronutrients mixture on growth of okra (*A. esculentus*).

Treatment	Plant height 60 DAS (cm)	Plant height 90DAS (cm)	Number of leaves/plant	Main stem diameter (cm)	No. of primary branch/plant	Days to first flower bud emergence
T_0 Control	64.20	67.66	34.53	3.50	2.77	40.73
T_1 (V_1)	65.93	68.72	37.77	3.51	3.07	39.80
T_2 (V_2)	66.17	68.90	39.21	3.63	3.47	39.30
T_3 (M)	68.99	71.11	38.45	3.73	3.07	39.10
T_4 (Z_1)	68.38	69.85	40.49	3.52	3.10	38.60
T_5 (Z_2)	68.62	70.82	35.51	3.71	3.40	38.00
T_6 (V_1+M)	69.08	73.73	40.09	4.02	3.63	37.63
T_7 (V_1+Z_1)	67.68	71.96	40.44	4.00	3.53	37.50
T_8 (V_1+Z_2)	67.95	72.42	38.90	4.19	3.73	36.48
T_9 (V_1+M+Z_1)	68.22	74.53	36.62	3.87	3.67	36.54
T_{10} (V_1+M+Z_2)	68.95	75.33	38.01	4.37	3.77	36.47
T_{11} (V_2+M)	70.04	76.66	36.07	4.51	3.97	35.80
T_{12} (V_2+Z_1)	70.52	77.77	38.17	4.67	4.13	36.00
T_{13} (V_2+Z_2)	71.51	77.93	37.78	4.78	4.47	35.13
T_{14} (V_2+M+Z_1)	73.96	78.12	41.79	5.32	4.87	34.23
T_{15} (V_2+M+Z_2)	74.00	79.71	43.17	5.52	5.10	33.53
CD at 5%	4.04	4.76	1.01	0.51	0.30	0.74
SEm±	1.98	2.33	0.49	0.25	0.14	0.36

Conclusion

It is postulated that the vermicompost 2tons and 4tons +mycorrhiza seed treatment + micronutrients mixture 50ppm and 100ppm may positively regulate the okra growth improved. The increasing plant height after 60 DAS(74cm), plant height after 90 DAS (79.71cm), number of leaves / plant (43.17), main steam diameter (5.52cm), primary branches per plant (5.10), days to first flower bud emergence (33.53 DAS) okra (*A. esculentus*) over the control. It was clearly evidenced that plant height, number of leaves per plant, main stem diameter, stem girth, number of primary branches increased significantly due to application of different levels of vermicompost, mycorrhiza and micronutrients mixture as compared to control. Therefore, the findings indicated that combination of vermicompost, mycorrhiza and micronutrients mixture played a significant role on enhancing the growth of okra (*A. esculentus*).

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